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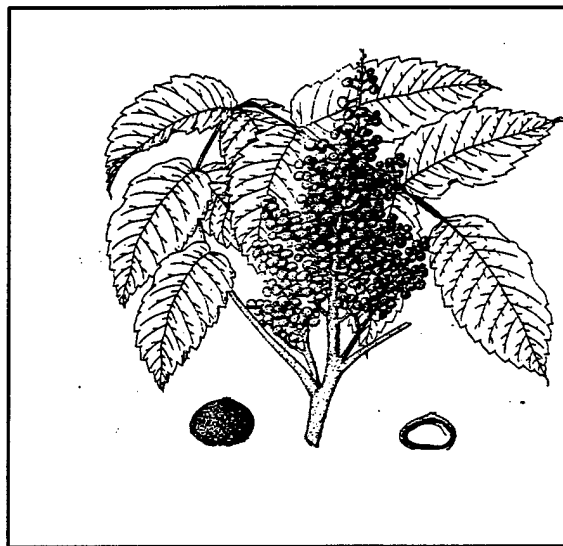
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February 1998

# Plant Community Composition of *Rhus michauxii* Colonies at Fort Pickett Military Reservation, Virginia

With an Ecological Assessment of Colonies Located on Ranges 15 and 16

by  
Verl Emrick and Alison Hill



*Rhus michauxii*, a federally listed endangered species, was discovered at Fort Pickett Military Reservation, Virginia in 1993. Previous work had determined the locations of known colonies, the amount of hybridization with *R. glabra*, the seed viability and stem density of *R. michauxii*. There were two primary objectives of this study: (1) summarize previously gathered data on the community composition of *R. michauxii* colonies, and (2) ecologically assess colonies, using set criteria, that might be affected by the proposed construction of a Multi-Purpose Range Complex (MPRC). Researchers gathered the community composition data under the auspices of the Army's Land Condition Trend Analysis program. A series of relevés were located in the larger colonies of *R. michauxii* to determine plant community composition. Soil core samples were also collected. *R. michauxii* colonies occurred in two associations at Fort Pickett: the oak woodland and open shrubland

associations. *R. michauxii* vegetative cover was highest in the open shrubland association. Differences in the floristic and physiognomic composition of the two associations were likely due to differing levels of disturbance. Soil core samples in *R. michauxii* associations were significantly higher in pH and concentrations of Ca, P, and K than other associations sampled at Fort Pickett. A majority of the ecologically assessed colonies were in the open shrubland association and had reproductive structures. Most of the colonies have the potential to be affected by the construction of the proposed MPRC. Whether these effects will be positive or negative has yet to be determined.

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13. ABSTRACT (Maximum 200 words) <i>Rhus michauxii</i> , a federally listed endangered species, was discovered at Fort Pickett Military Reservation, Virginia in 1993. Previous work had determined the locations of known colonies, the amount of hybridization with <i>R. glabra</i> , the seed viability and stem density of <i>R. michauxii</i> . There were two primary objectives of this study: (1) summarize previously gathered data on the community composition of <i>R. michauxii</i> colonies, and (2) ecologically assess colonies, using set criteria, that might be affected by the proposed construction of a Multi-Purpose Range Complex (MPRC). Researchers gathered the community composition data under the auspices of the Army's Land Condition Trend Analysis program. A series of releves were located in the larger colonies of <i>R. michauxii</i> to determine plant community composition. Soil core samples were also collected. <i>R. michauxii</i> colonies occurred in two associations at Fort Pickett: the oak woodland and open shrubland associations. <i>R. michauxii</i> vegetative cover was highest in the open shrubland association. Differences in the floristic and physiognomic composition of the two associations were likely due to differing levels of disturbance. Soil core samples in <i>R. michauxii</i> associations were significantly higher in pH and concentrations of Ca, P, and K than other associations sampled at Fort Pickett. A majority of the ecologically assessed colonies were in the open shrubland association and had reproductive structures. Most of the colonies have the potential to be affected by the construction of the proposed MPRC. Whether these effects will be positive or negative has yet to be determined.					
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## Foreword

This study was conducted for Commander, U.S. Army Garrison, Fort Pickett under Military Interdepartmental Purchase Request (MIPR) 7FCERL0114, Work Unit 001FC7, "Proposal for Supporting Military Training by Conducting an Ecological Assessment of Michaux's Sumac (*Rhus michauxii*) Colonies in the Controlled Access Area at Fort Pickett Military Reservation, Virginia." The technical monitor was Robert Wheeler, AFRC-FMP-PW.

The work was performed by Verl Emrick of the Natural Resources Assessment and Management Division (LL-N) of the Land Management Laboratory (LL), U.S. Army Construction Engineering Research Laboratories (USACERL). The USACERL principal investigator was Dr. Alison Hill. Dr. William D. Severinghaus is Operations Chief, CECER-LL. The USACERL technical editor was Gloria J. Wienke, Technical Resources Team.

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COL James A. Walter is Commander of USACERL and Dr. Michael J. O'Connor is Director.

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## **Distribution**



# 1 Introduction

## Background

Michaux's sumac (*Rhus michauxii* Sargent) is an entomophilous, usually dioecious, rhizomatous shrub in the Anacardiaceae family. The entire plant is densely pubescent and typically 1.5 to 4 dm in height (Radford, Ahles, and Bell 1968; Hardin and Phillips 1985a). Michaux's sumac was first described by Sargent (1895) who considered it "...one of the most poisonous plants in North America." It has subsequently been found to be nonpoisonous, hence one of its colloquial names, False poison sumac. *R. michauxii* was designated as endangered by the U.S. Fish and Wildlife Service (USFWS) on October 30, 1989 (USFWS 1993). North Carolina, Georgia, and Virginia list *R. michauxii* as endangered, while South Carolina considers it of "National Concern," though it has apparently been extirpated from the state (Russo 1993). *R. michauxii*'s former range was from north-central Florida to Virginia, where it occurred in the inner coastal plain and lower piedmont of the southeastern Atlantic states. At the time of this study there were 26 known populations. Twenty-four of these occurred in North Carolina and one each in Virginia and Georgia (Russo 1993). The Virginia population, on Fort Pickett, is believed to be the largest known population and is composed of numerous colonies.

The primary means of reproduction for *R. michauxii* populations is asexual clonal growth (Sherman-Broyles et al. 1992; Russo 1993). Sexual reproduction in North Carolina sandhill populations is limited because many populations are single sex (Savage and Bucher 1991). However, the Fort Pickett population consists of many colonies that are comprised of both staminate and pistillate individuals and at least one colony containing monoecious individuals (Emrick and Hill 1997). Wilkinson, Demarco, and Jones (1996) reported that viable seed is being produced in several colonies at Fort Pickett. In addition, many staminate and pistillate flowers observed in 1997 contained vestigial structures of the opposite sex. Cronquist (1981) reports this phenomenon for other species in this genera, but not for *R. michauxii*.

Genetic and taxonomic studies have indicated a close phylogenetic relationship between *R. michauxii* and *R. glabra* L., or Smooth sumac (Hardin and Phillips 1985b; Sherman-Broyles et al. 1992; Burke and Hamrick 1995). Sherman-Broyles

et al. (1992) suggested that *R. glabra* might, in fact, be the progenitor of *R. michauxii*. The flowering times of *R. michauxii* and *R. glabra* overlap by approximately a third (Radford et al. 1968). An interspecific hybrid has been observed *in situ* and been cultivated and studied in greenhouse experiments (Hardin and Phillips 1985b). Fleming and Van Alstine (1994) and Smith and Van Alstine (1995) identified morphologically intermediate plants at Fort Pickett, which were believed to be interspecific hybrids. Burke and Hamrick (1995) reported that while hybridization is occurring at Fort Pickett, it seems local in nature. In addition, they noted that the Fort Pickett population was genetically more diverse than populations studied in North Carolina.

This study is a continuation of research and management efforts by the Fort Pickett Fish and Wildlife Management Branch, now called the Natural Resources Office (NRO). These efforts began in 1994, and were a direct result of having discovered the plant on the installation the previous year. Other research efforts sought to describe *R. michauxii*'s occurrence (Flemming and Van Alstine 1994), identify its distribution (Smith and Van Alstine 1995), report the level of hybridization and genetic diversity (Burke and Hamrick 1995), investigate its seed viability (Wilkinson, Demarco, and Jones 1996), and survey its stem density (Emrick and Hill 1997).

In 1994 the Land Condition Trend Analysis (LCTA) program was initiated at Fort Pickett. LCTA's primary goal was to determine the composition and monitor important plant communities, including *R. michauxii* communities, across the installation. Current installation research and management efforts are focused on the potential effects of the possible construction of a Multi-Purpose Range Complex (MPRC) on *R. michauxii* colonies and other natural resources.

## Objectives

The two specific objectives of this study were to:

1. Describe the methods used to inventory and summarize plant community data collected from 1994 through 1996 and discuss the results, and
2. Ecologically assess all colonies of *R. michauxii* occurring within ranges 15 and 16 that could potentially be affected by the construction of the proposed MPRC.

## Approach

To fulfill the stated objectives, the following approach was taken:

1. Summarize the plant community and soils data collected in 1994 through 1996,
2. Visit colonies within ranges 15 and 16 and their range fans,
3. Confirm accuracy of the location map,
4. Ecologically evaluate each colony using established criterion,
5. Analyze the plant community data, soils data, ecological assessment data, and
6. Report the results.

## 2 Study Site

### Physical Setting and Climate

Fort Pickett is in southeastern Virginia, approximately 100 kilometers southwest of Richmond, near the town of Blackstone. Fort Pickett is in the Piedmont physiographic region, located approximately 25 km west of the fall line demarcating the coastal plain. Underlying geology consists primarily of older Precambrian gneiss, schist, and Petersburg granite. Physiographically, the installation is characterized by gently rolling topography with elevations ranging between 60 and 130 meters above sea level. The installation has approximately 210 ha of ponds and reservoirs, and 200 ha of wetlands. Soils are generally well-drained, nutrient poor, sandy loams that are susceptible to drought and generally fall into one of the following associations: (1) Appling-Cecil-Durham; (2) Appling-Louisburg-Cecil; (3) Appling-Durham-Louisburg; or (4) Durham-Appling-Worsham (U.S. Soil Conservation Service [USSCS] 1960).

The winters are mild and the summers are hot and humid. Seasonal mean temperatures are: 14°C in spring, 25°C in summer, 16°C in autumn, and 4°C in winter. Average relative humidity is 54%. Rainfall is fairly evenly distributed throughout the year and averages 102+ centimeters (Flemming and Van Alstine 1994).

The installation covers 18,282 ha (181 km<sup>2</sup>) in portions of three counties: Nottoway, Dinwiddie, and Brunswick. *R. michauxii* colonies are found primarily in Nottoway and Dinwiddie counties, with two small colonies in Brunswick County. There are approximately 10,120 ha of training land available for infantry, armor, and mechanized training. In addition, a 4,251-ha Controlled Access Area (CAA) serves as a buffer zone for various live-fire exercises. The remaining area consists of the cantonment area, airfield, improved grounds, and an agricultural research station leased to Virginia Polytechnic Institute.

## Vegetation

Major vegetation types occurring at Fort Pickett are those typically found within the eastern deciduous forest. About 5 percent (1,012 ha) of the training land at Fort Pickett is maintained in mid-early successional stages (grassland/scrubland) for military training activities and wildlife management purposes. The floristic composition of these areas was examined in detail during 1994 under the auspices of the LCTA program (Emrick and Proffitt 1996). However, a majority (approximately 15,000 ha) of the installation is covered in second growth forest cover types that are typical of the eastern deciduous forest (Braun 1950). The following five forest cover types are the most common:

1. natural and planted pine
2. pine-hardwood
3. upland hardwood
4. bottomland hardwood
5. swamp hardwood.

Map Insert 1 shows the distribution and location of all known *R. michauxii* colonies on Fort Pickett. Virtually all of the *R. michauxii* colonies occur within the CAA. The CAA serves as a buffer zone for the existing live-fire range complex that supports various small arms, tank, and artillery training. Throughout the installation's 54-year history, tactical arms training has resulted in wildfires that burn the CAA annually or bi-annually. These fires are usually moderately intense ground fires that are allowed to burn unhindered within the CAA; only rarely do they result in intense crown fires. As a result, a unique mosaic of pyric disclimax plant communities, such as loblolly pine savannas, oak/hickory woodlands, and little bluestem grasslands, has developed within the CAA (Flemming and Van Alstine 1994; Emrick and Proffitt 1996).

## Training Mission

Fort Pickett's mission is to provide tracked and wheeled vehicle maneuver and training areas, while also providing live-fire tank and artillery ranges for the Army's National Guard, Reserve Components, Active Army, and other military services.

### 3 Methods

#### Plant Community Composition

The methods for determining plant community composition were based on the releve technique developed by Braun-Blanquet (1932). For a complete discussion of the releve technique consult Poore (1955). Species area curves determined plot sizes, following guidelines of Mueller-Dombois and Ellenberg (1974). Plot sizes and corresponding physiognomic types were:

1. 10m x 10m for highly disturbed scrubland and grassland types that had little woody component above 2 meters; and
2. 20m x 20m for woodlands that had a significant amount of woody vegetation above 2 meters.

Eleven permanent vegetation plots were randomly established in the larger (>500 m<sup>2</sup>) colonies of *R. michauxii* in 1994. As other large colonies were discovered, additional plots were established; one each in 1995 and 1996. All vegetation plots were located in colonies within the CAA.

Vegetative communities were inventoried using the following **height** categories: 0 to 1m herb stratum, 1 to 6m shrub stratum, and 6+m tree stratum. Every plant occurring in each stratum was named to species level and its aerial vegetative cover estimated using the Braun-Blanquet cover abundance scale (Table 1; Mueller-Dombois and Ellenberg 1974; Bonham 1989). Blank copies of the field data sheets used can be found in Appendix A.

#### Soils

Soil core samples were collected to compare *Rhus* communities with non-*Rhus* communities. A total of 110 soil samples were collected, 84 (76 percent) from non-*Rhus* and 26 (24 percent) from *Rhus* communities. Of the 26 *Rhus* samples, 9 were collected from an area immediately adjacent to the releve plots and 17 were collected from other *R. michauxii* colonies within the CAA. The 84 non-*Rhus* soil samples, were taken from mid-successional habitat on LCTA plots outside the CAA. A & L

Table 1. Braun-Blanquet cover abundance scale and class midpoints (Mueller-Dombois & Ellenberg, 1974).

% Cover	Braun-Blanquet Symbol	Class Midpoints
75 - 100	5	87.5
50 - 75	4	62.5
25 - 50	3	37.5
5 - 25	2	15.0
1 - 5	1	2.5
< 1.0 , few / low cover	+	1
rare / essentially no cover	r	

Eastern Agricultural Laboratories, Inc. analyzed the soil samples for percent organic matter, pH, textural qualities, and concentrations of P, Ca, K, and Mg.

## Ecological Assessment

A large-scale, hardcopy "field map" of the immediate area surrounding the proposed MPRC was created to verify the *R. michauxii* colony locations and serve as the basis for ecologically assessing and describing each colony. The locations of the known *Rhus* colonies came from three sources. Information was extracted from Virginia Natural Heritage element occurrence maps (Flemming and Van Alstine 1994; Smith and Van Alstine 1995) and from Fort Pickett's NRO endangered species maps. Information was then verified with former and current staff members so that a map could be created to show the location of the *R. michauxii* colonies across the entire installation (Map Insert 1). The approximate location of the proposed MPRC was then overlaid on the *Rhus* locations to determine what construction activities will occur in the vicinity of each colony.\* Map Insert 2 shows the locations of the colonies assessed, the colony identifications, and the preliminary locations of the proposed MPRC buildings, roads, and targets.

The colonies chosen for the ecological assessment were selected because of their proximity to the construction zone of the proposed MPRC. Field work for the assessment was designed to accomplish two purposes: (1) confirm the locations of each previously identified colony, and (2) ecologically assess the colony based upon

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\* The location of the roads, buildings, etc. associated with proposed MPRC are approximate. Final plans are not currently available. The locations were used to determine which *R. michauxii* colonies might potentially be affected by the construction.

set criteria. In the summer of 1997, Fort Pickett NRO and USACERL personnel navigated to each colony using compasses and a Global Positioning System (GPS). Each colony was traversed several times and ecological information noted on a colony information data sheet (Appendix A). The ecological information recorded at each colony included:

- aspect and slope
- site disturbance regimes (evidence of old impact craters, recent fires, fire-damaged trees, unexploded munitions, shrapnel)
- general colony size (3 classes: Small  $<25\text{m}^2$ , Medium  $25\text{-}200\text{m}^2$ , and Large  $>200\text{m}^2$ )
- vegetation
  - total cover
  - dominant species by stratum
- *R. michauxii* information
  - cover (3 height classes:  $<1\text{ m}$ ,  $1\text{-}2\text{ m}$ ,  $2\text{+m}$ )
  - presence/absence of seed heads
  - presence/absence of flowers and their sex

Data and information from other studies (e.g., Flemming and Van Alstine 1994; Smith and Van Alstine 1996; Emrick and Hill 1997) supplemented the field-gathered information. Further information was also obtained from conversations with Fort Pickett NRO employees.



## 4 Data Analysis and Summarization

### Plant Community Composition

The goal of the plant community data analysis was to determine the community associations of the *R. michauxii* colonies and describe the composition of the associations. This information was then used for the subsequent ecological assessment. The classification of the releve plots and the description of *R. michauxii* associations was a two-step process:

1. multivariate analysis of releve plot data, and
2. naming and describing community associations.

#### *Multivariate Analysis*

Three multivariate classification techniques were used to assist in the interpretation of the vegetation data: hierarchical clustering, multidimensional scaling, and nonhierarchical clustering. The releve plot data, using the class midpoints outlined in Table 1, were arranged by height strata in a samples-by-species abundance matrix, with each releve plot representing a sample (Gauch 1982). Species receiving a rare cover abundance were excluded from the matrix. Data on slope, soil chemistry and aspect were also excluded from the final analysis because no discernible patterns were evident.

Sample dissimilarity, using the percentage difference algorithm, was calculated and samples hierarchically clustered by the unweighted pair-group method using arithmetic averages (Gauch and Whittaker 1981, Gauch 1982, Krebs 1989). Dendrograms were generated and then interpreted following the suggestions of Faith (1992).

Multidimensional scaling (principal coordinates analysis), using the percentage difference algorithm, was performed. The results were displayed in a two-dimensional metric space and then interpreted following the guidelines of Gauch (1982).

Nonhierarchical clustering was subsequently used to assign the plots to groups ostensibly representing community associations. Nonhierarchical clustering requires the investigator to specify the number of clusters into which the plots will be assigned. The interpretation of the dendrograms from the hierarchical clustering, multidimensional scaling, and field observations were used to determine the number of ecologically significant clusters to specify. Two clustering cycles were performed: one specifying three clusters and the other specifying two clusters. Both cycles were performed by calculating sample dissimilarity using the percentage difference algorithm.

### ***Naming and Description of Plant Communities***

The resulting association tables were examined. Limited association table work was used to refine the classification further, resulting in the final community associations. The associations were summarized by calculating mean cover for each species in each of the height strata in which it occurs. The community associations were named according to the guidelines of the Standardized National Vegetation Classification System (SNVCS) developed by the Nature Conservancy (1994).

### **Soils**

Soil data from all *R. michauxii* locations were pooled. Means and standard deviations were calculated for soil pH, percent organic matter, and concentrations of P, Ca, Mg, and K. Statistical means of the different soil parameters were compared using a paired sample T-test (Systat 5.05, 1992). Soil data from the LCTA plots not containing *R. michauxii* were summarized in the same manner.

### **Ecological Assessment**

The ecological information gathered was summarized and put into tabular format. Vegetative cover (herein referred to as cover) values were reported using the class midpoints in Table 1. Each of the medium and large size class colonies were classified into one of the two community associations, based upon dominant species, identified from the community data collected from 1994 through 1996. A complete summary of the ecological information gathered on each colony is located in Appendix B.

## 5 Results

### Plant Community Composition

The classification process resulted in the identification of two community associations. Figure 1 displays the results of the hierarchical clustering procedure with the two community associations noted. Nomenclature follows Radford et al. (1968), with the exception of *Schizachyrium scoparium* Nash.

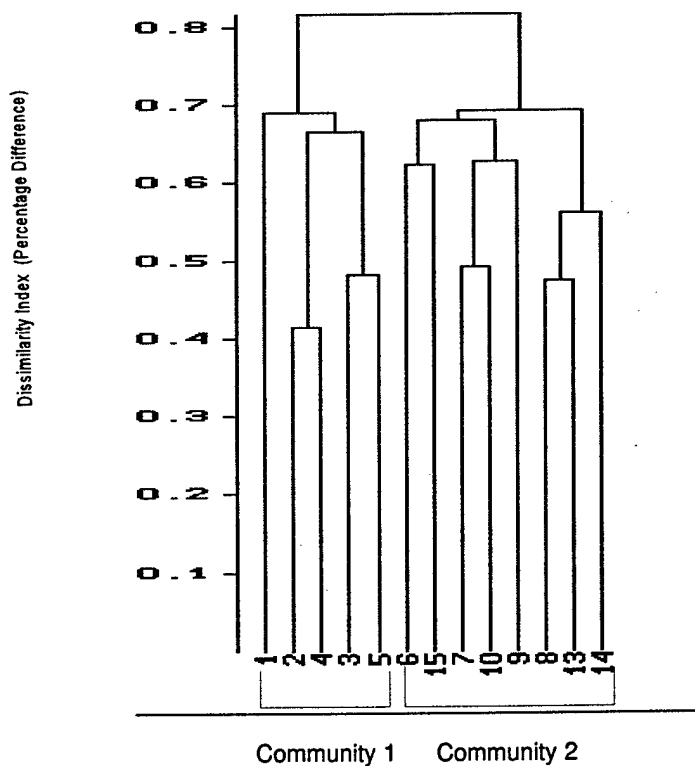


Figure 1. Dendrogram of the results of hierarchical clustering of *Rhus michauxii* LCTA releve plots showing the two identified community associations.

The identified associations were:\*

1. *Quercus falcata* Mich. / *Quercus alba* L. - *Liquidambar styraciflua* / *Carya tomentosa* Nutt. - *Schizachyrium scoparium* woodland association.

In this oak woodland association, *Quercus* spp. had the highest mean cover in the tree stratum while *Carya tomentosa* and *C. glabra* (Sweet) exhibited somewhat lower cover (Figure 2). The total mean cover of the tree stratum was 40 percent. According to the SNVCS, the association would be a woodland. The shrub stratum was sparse in this association with a mean total vegetative cover of 20 percent. *Liquidambar styraciflua* and *Carya tomentosa* were the species with the highest cover in the shrub stratum (Figure 3). Other species of note occurring in the shrub stratum were *C. glabra* and *Juglans nigra* L. There was a wide disparity in species cover occurring in the herb stratum (Figure 4). *Schizachyrium scoparium* completely dominated the herb stratum with a mean cover of 40 percent. *Rhus michauxii* had the next highest mean cover (12.5 percent) and was not considered codominant in the herb stratum. *Coreopsis verticillata* L., *Clitoria mariana* L. and hardwood stump sprouts were also common constituents in the herb stratum. The disturbance regime primarily consisted of low to moderately intense ground fires caused by munition explosions and other military training activities with little resulting disturbance. No correlation was evident between the environmental variables (i.e., slope, aspect, and soil chemistry) and the distribution and occurrence of this association.

2. *Carya tomentosa* / *Quercus velutina* - *Schizachyrium scoparium* / *Lespedeza cuneata* G Don - *Rhus michauxii* / *Rubus flagellaris* open shrubland association.

*Carya tomentosa* and *Quercus velutina* exhibited the highest mean cover in the open shrubland association (Figure 2). In contrast to the oak woodland association, all species occurring in the tree stratum were either in the *Carya* or *Quercus* genus. The association's tree stratum was poorly developed. The few individuals that did occur exhibited extreme fire and mechanical damage to both the trunks and crowns. Consequently, the mean total cover was less than 10 percent. According to the NVCS, this association was physiognomically classified as an open shrubland. Because of its open nature, herbs and forbs grew vigorously and attained heights

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\* Species separated by a dash are in different height strata. Species separated by slash are codominant in that height strata. When codominants occur in a particular height stratum, the first one listed is the most dominant.

## Tree Stratum (6+ meters)

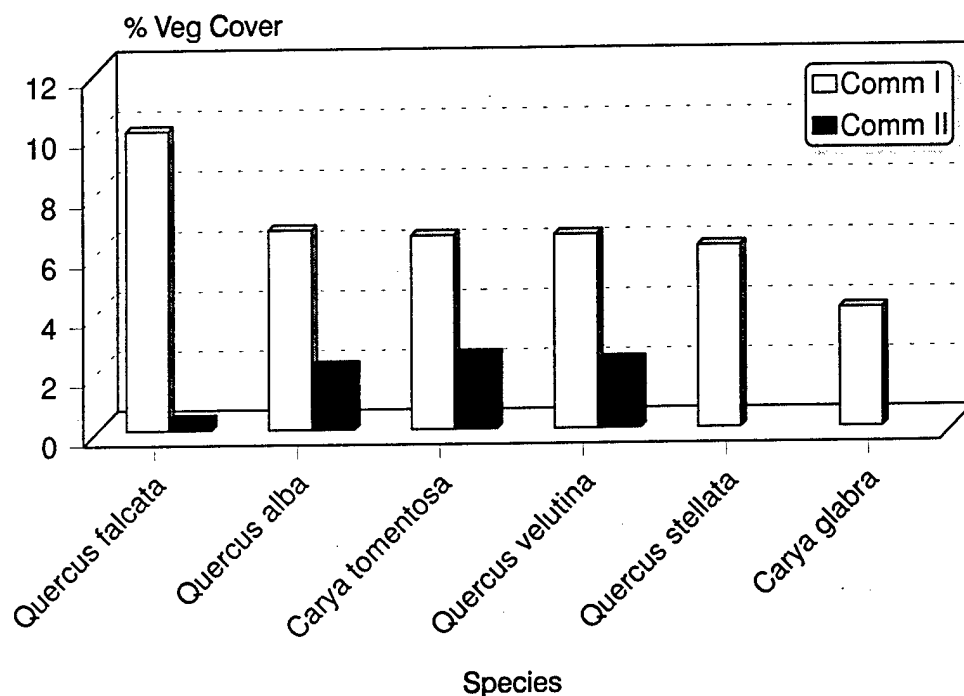


Figure 2. Species with the highest cover in the tree stratum (6+ meters) in the two associations containing *Rhus michauxii* at Fort Pickett, Virginia.

## Shrub Stratum (1-6 meters)

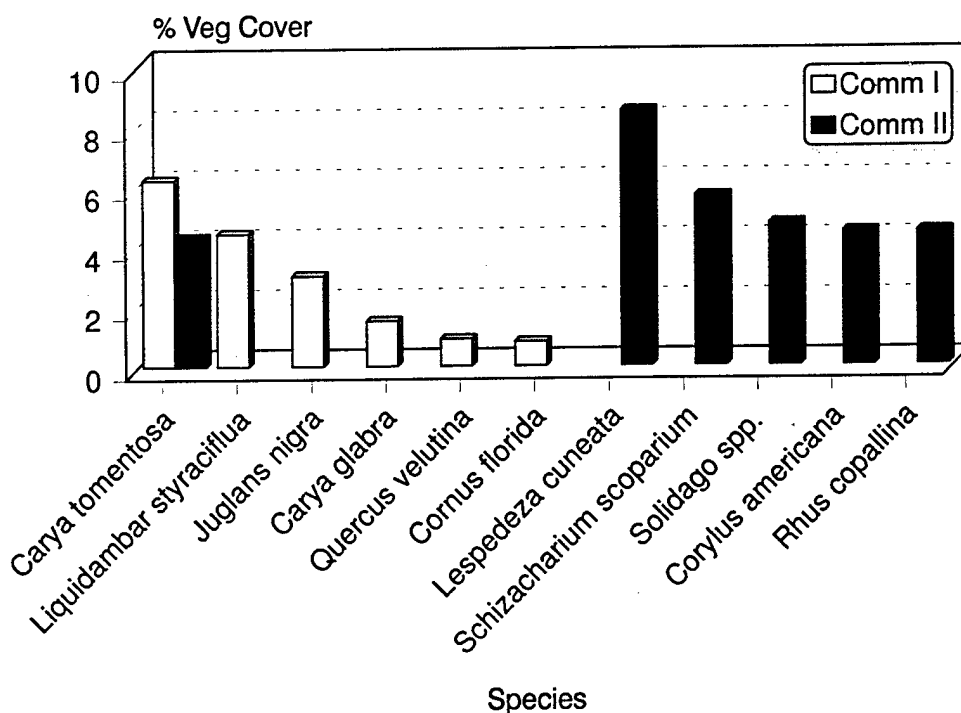


Figure 3. Species with the highest cover in the shrub stratum (1 to 6 meters) in the two associations containing *Rhus michauxii* at Fort Pickett, Virginia.

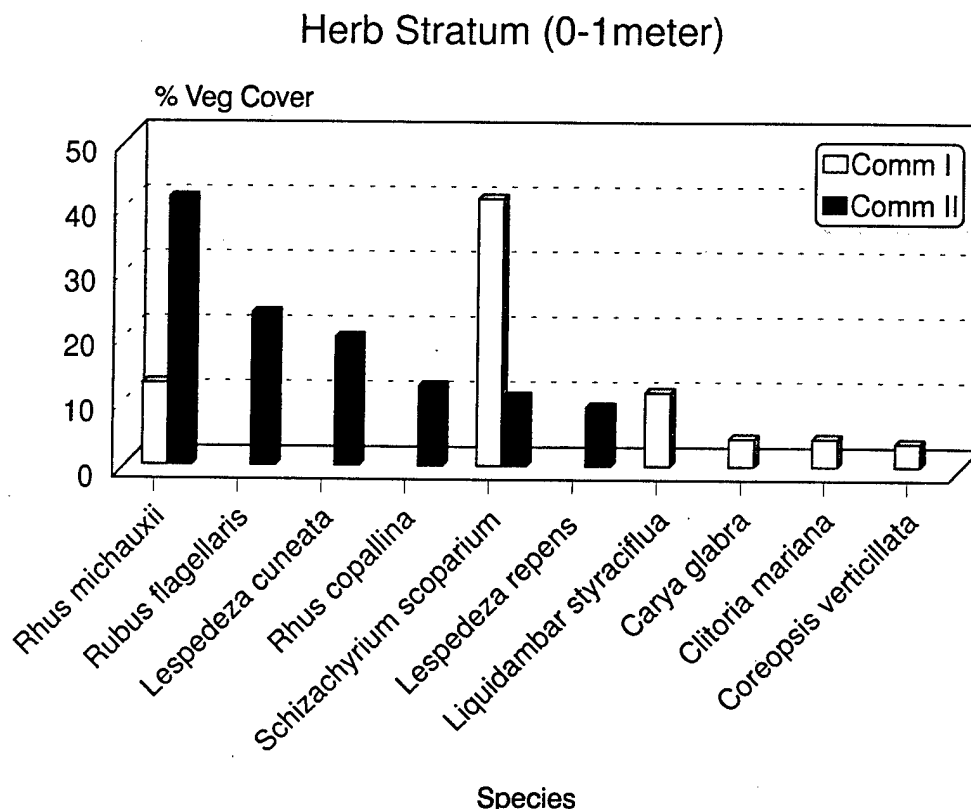


Figure 4. Species with the highest cover in the herb stratum (0 to 1 meter) in the two associations containing *Rhus michauxii* at Fort Pickett, Virginia.

more than 1 meter, resulting in a total mean cover in the shrub stratum of 60 percent. As a result, *Lespedeza cuneata* and *S. scoparium* were dominant shrub stratum components (Figure 3). Other species of note that exhibited high cover in the shrub stratum were: *Solidago* spp., *R. copallina*, and *Desmodium nudiflorum* (L.) DC. In contrast to the oak woodland association, *R. michauxii* had the highest mean cover (41 percent) in the herb stratum. Other associates that had relatively high mean cover were: *L. cuneata*, *S. scoparium*, *R. flagellaris*, and *L. repens* (L.) Barton. This association occurred where the disturbance level was noticeably greater than in the oak woodland association. There were numerous impact craters and other types of physical soil disturbance caused by military training evident in all colonies within this association.

## Soils

The means, minimums, maximums, and standard deviations for the soil parameters are reported in Table 2. Soil from *R. michauxii* associations was significantly ( $P < 0.05$ ) higher in pH, and had significantly higher concentrations of P, Ca, and K than the non-*R. michauxii* associations. However, Ca and P data were highly variable

Table 2. Soil characteristics and paired t-test samples of *Rhus michauxii* colonies and non-*R. Michauxii* plots for 1994.

<i>Rhus michauxii</i> Communities (n=26)					Non- <i>Rhus michauxii</i> Communities (n=84)				
	Min.	Max.	Mean	Std. Dev	Min.	Max.	Mean	Std. Dev	Prob.
pH	5.0	7.7	5.92*	0.68	4.2	7.4	5.01*	0.59	P<0.05
P	2.5	34.0	11.00*	7.27	2.0	47.0	7.07*	5.86	P<0.05
Ca	3.0	1630.0	637.69*	400.96	30.0	800.0	235.24*	157.31	P<0.05
K	160.0	198.0	86.38*	42.20	12.0	170.0	54.09*	27.70	P<0.05
Mg	43.0	119.0	55.77	25.75	6.0	190.0	53.35	38.18	P>0.05
%Org.	0.0	6.3	3.91	1.30	1.1	6.9	3.06	1.20	P>0.05

\* denotes mean values that were significantly different at the P<0.05 level. *Rhus michauxii* communities (n=26) non-*Rhus michauxii* communities (n=84).

and the results should be considered preliminary. There was no significant difference ( $P > 0.05$ ) in Mg concentration and percent organic matter between the two associations. Textural quality of the *R. michauxii* soil samples was classified as either sandy loam or loamy sand. Non-*R. michauxii* soil samples were also texturally classified as sandy loam or loamy sand, with clay loam occurring in just a few (six) samples.

## Ecological Assessment

The ecological information gathered on the *R. michauxii* colonies on tank ranges 15 and 16 is summarized in Tables 3 and 4. Nearly all of the colonies (94 percent) exhibited some sign of disturbance caused by military training. Colony OL1-11 was the only colony without recent signs of military-caused disturbance and did not fit into either of the identified associations. Overall, the cover was generally high below 1 meter but was highly variable above 1 meter. *R. michauxii* cover was fairly consistent, with the highest cover found in colonies with limited cover above three meters. The open shrubland association was the most common, occurring in 72% of the colonies classified. A majority (66%) of the colonies had reproductive structures observed in the colony. The construction of the various roads, buildings and tree clearing associated with the construction of the proposed MPRC (Map Insert 2) has the potential to affect 15 of the 18 colonies (83%). Of the colonies potentially affected by the construction of the proposed MPRC, 66 percent have reproductive structures.

Table 3. Summary of the vegetation information gathered for the ecological assessment of *Rhus michauxii* colonies on ranges 15 and 16.

Colony ID	<i>R. michauxii</i> Cover	Total Cover 0-1 m	Total Cover 1-3 m	Total Cover 3-6 m	Total Cover 6+ m	Community Association*
OL1-1	37.5	87.5	37.5	2.5	37.5	I
OL1-2	15.0	87.5		2.5	15.0	n/a
OL1-3	15.0	87.5	15.0	37.5	15.0	II
OL1-4	2.5	87.5	37.5	2.5	2.5	II
OL1-5	2.5	87.5	15.0	15.0	2.5	II
OL1-6	15.0	87.5	15.0	2.5	2.5	n/a
OL1-7	15.0	62.5		15.0	2.5	n/a
OL1-8	15.0	87.5	2.5	2.5	2.5	II
OL1-9	15.0	62.5	15.0	15.0		n/a
OL1-10	2.5	87.5				n/a
OL1-11	15.0	62.5	62.5	37.5	37.5	**
OL1-12	37.5	87.5	62.5			II
OL1-13	15.0	87.5	87.5			II
OL1-14	15.0	62.5	15.0			II
OL1-15	37.5	87.5	62.5			II
OL1-16	2.5	62.5	2.5			II
OL1-17	15.0	62.5		37.5	15.0	I
OL1-18	37.5	62.5	37.5	15.0		II

\* **Community I** is a *Quercus falcata* Michx / *Quercus alba* L. - *Liquidambar styraciflua* / *Carya tomentosa* Nott. - *Schizachyrium scoparium* woodland association. **Community II** is a *Carya tomentosa* / *Quercus velutina* - *Schizachyrium scoparium* / *Lespedeza cuneata* G Don - *Rhus michauxii* / *Rubus flagellaris* open shrubland association.

\*\* OL1-11 did not fit into either of the identified associations.



Table 4. Summary of environmental and reproductive information gathered for the ecological assessment of *Rhus michauxii* colonies on ranges 15 and 16.

Colony ID	Aspect	Slope	Disturbance Regime	Colony Size	Reproductive Structures	Potential MPRC Dist.
OL1-1	30°	<5%	IC, RF, FST, M/S	M	PF, SF, SH	TC
OL1-2	--	--	IC, FST, RF	S	SH	TC, PB
OL1-3	139°	<5%	RF, FST, M/S	L	SH, SF	TC, PB, PR
OL1-4	297°	<5%	RF, FST	M	--	TC, PB, PR
OL1-5	290°	<5%	IC, RF, FST, M/S	M	UF	TC, PB, PR
OL1-6	--	--	RF, ST	S	UF	PR
OL1-7	--	--	IC, RF, FST, M/S	S	--	TC
OL1-8	200°	8%	IC, RF, FST, M/S	M	SH, UF	TC
OL1-9	45°	<5%	IC, FST, M/S	S	SH, UF	TC
OL1-10	240°	<5%	RF	S	--	TC
OL1-11	290°	12%	--	L	UF	TC, PR
OL1-12	45°	<5%	IC, FST, M/S	L	SH, PF, SF	TC, PB, PR
OL1-13	45°	10%	IC, FST, M/S	L	--	TC, PB, PR
OL1-14	45°	32%	IC, FST, M/S	L	--	TC, PB, PR
OL1-15	45°	10%	IC, FST, M/S	L	SH, UF	TC, PB, PR
OL1-16	225°	<5%	IC, FST, RF, M/S	M	SH, UF	--
OL1-17	90°	<5%	IC, FST, M/S, RF	M	--	--
OL1-18	--	--	IC, FST, M/S, RF	L	SH, PF, SF	--

**Disturbance regime:** IC (impact craters), FST (fire scarred trees), RF (recent fires), M/S (munitions/shrapnel).  
**Colony Size:** S (<25m<sup>2</sup>), M (25-200m<sup>2</sup>), and L (>200m<sup>2</sup>).  
**Reproductive Structures:** PF (pistillate flowers), SF (staminate flowers), UF (flowers of unknown gender), SH (seed heads).  
**Potential MPRC Disturbance:** TC (tree clearing zone), PR (proposed roads), PB (proposed buildings).

## 6 Discussion

### Plant Community Composition and Soils

Several key vegetative features differentiated the two associations. In the oak woodland association, the total cover of the tree stratum was always in excess of 30 percent. In the open shrubland association, total cover rarely exceeded 10 percent. In addition, *R. michauxii* cover was conspicuously greater in the herb stratum within the open shrubland association. *Lespedeza cuneata* was virtually absent from the herb stratum and nonexistent in the shrub stratum within the oak woodland association. However, *L. cuneata* was a major component of both the herb and shrub strata in the open shrubland association. The variations in the environment (i.e., sunlight and moisture) caused by differences in tree stratum coverage probably led to the floristic compositional differences between the two associations.

A gradient of disturbance intensity was in all likelihood responsible for physiognomic and floristic differences between the two associations. The oak woodland association was located primarily in regions of the CAA that were not exposed to the direct impacts of artillery firing or other intense military disturbance. Whereas the open shrubland association often occurred in closer proximity to firing points, impact areas, and observation posts where the intensity of disturbance was much greater. The sparse to nonexistent tree stratum in the open shrubland association was a result of mechanical damage by munition explosions and wildfire.

The higher cover in the open shrubland association suggested that *R. michauxii* is adapted to fairly intense levels of disturbance. There were many instances in the open shrubland association where old artillery impact craters were found to be almost completely covered with *R. michauxii* ramets. The rhizomatous nature of *R. michauxii* probably allowed it to rapidly colonize newly disturbed soil through clonal reproduction. Consequently, the higher level of disturbance associated with the open shrubland association may have resulted in more opportunities for growth and expansion, and the higher cover of *R. michauxii* in this association.

Many species were common to both associations. A vast majority of the dominant species in the herb stratum in the woodland association were present, albeit at lower cover, in the open shrubland association. The same is true of the dominant species

in the herb stratum of the open shrubland (Table 5). The tree stratum also followed a similar pattern. Furthermore, 74 percent of the species present in the open shrubland association were also present in the oak woodland association. The species unique to the open shrubland association (e.g., *Andropogon virginicus* L., *Daucus carota* L., *Chrysanthemum leucanthemum* L., and others) were typical early southeastern piedmont old field successional species and would not be expected to be present in the oak woodland association (Keever 1950). It is therefore possible that each association was a distinct seral stage of essentially the same plant community. The dynamic nature of the disturbance will likely result in some colonies oscillating between the two association types.

*Rhus michauxii* was not confined to just these two identified associations. However, only in these two associations, both of which only occurred within the CAA, did *R. michauxii* colonies reach an appreciable size ( $> 500\text{m}^2$ ) at Fort Pickett. Other small, scattered colonies occurred throughout and outside the CAA. These small colonies occurred on old road cuts, rights-of-way, and other areas that had received moderate to severe levels of disturbance throughout the installation's history.

The floristic composition of *R. michauxii* populations in the North Carolina sandhills were somewhat different from the Fort Pickett population. *Ceanothus americanus* L., *Paspalum bifidum* Nash, *Tridens carolinianus* Henrard, *Aristida lanosa* Muhl. ex Ell., *Onosmodium virginianum* A. DC, and *Helianthus divaricatus* L. were considered to be good indicators of *R. michauxii* habitats in North Carolina (Russo 1993). Flemming and Van Alstine (1994) listed several possible indicator species for *R. michauxii* at Fort Pickett (e.g., *Sorghastrum elliottii* Nash, *Silphium compositum* Michaux, and *Helianthus divaricatus* among others). However, most of the species in both associations were common throughout the CAA in various combinations (Emrick and Proffitt 1996). As a result, pinpointing indicator species was difficult. Russo (1993) reported that *R. michauxii* sandhill populations were characterized by a greater frequency of hardwoods. This was also the case with the Fort Pickett population. Furthermore, *R. michauxii* was never found in plant communities at Fort Pickett that contained any appreciable amount of *Pinus* spp.

*R. michauxii* was reported in North Carolina to "...be restricted to slightly loamy, but still well drained, sites that are scattered throughout the longleaf pine/scrub oak/wiregrass woodlands" (Russo, 1993). These sites are typically found in slight depressions and swales (Shafale and Weakely 1990). The occurrence of *R. michauxii* colonies was not correlated with any physiographic feature at Fort Pickett. The presence of *R. michauxii* colonies in one locale and not another might be better explained by examining past land use, disturbance regime, and its reproductive strategy.

Table 5. Comparison of vegetative cover of dominant species found in *Rhus michauxii* association at Fort Pickett.

Species	Mean Vegetative Cover (%) Community 1	Mean Vegetative Cover (%) Community 2
Tree stratum		
<i>Quercus falcata</i>	10.0	0.3
<i>Quercus alba</i>	6.7	2.1
<i>Carya tomentosa</i>	6.5	2.5
<i>Quercus velutina</i>	6.5	2.2
<i>Quercus stellata</i>	6.1	Absent
<i>Carya glabra</i>	4.0	Absent
Shrub stratum		
<i>Carya tomentosa</i>	6.2	4.2
<i>Liquidambar styraciflua</i>	4.4	0.8
<i>Juglans nigra</i>	3.0	0.1
<i>Carya glabra</i>	1.5	0.1
<i>Quercus velutina</i>	0.9	0.1
<i>Cornus florida</i>	0.8	0.3
<i>Lespedeza cuneata</i>	Absent	8.5
<i>Schizachyrium scoparius</i>	Absent	5.6
<i>Solidago spp.</i>	Absent	4.7
<i>Corylus americana</i>	Absent	4.4
<i>Rhus copallina</i>	Absent	4.4
Herb Stratum		
<i>Rhus michauxii</i>	12.5	41.0
<i>Rubus flagellaris</i>	0.8	23.3
<i>Lespedeza cuneata</i>	0.3	19.6
<i>Rhus copallina</i>	2.2	12.1
<i>Schizachyrium scoparius</i>	41.0	10.5
<i>Lespedeza repens</i>	0.2	8.9
<i>Liquidambar styraciflua</i>	11.2	3.1
<i>Carya glabra</i>	4.2	0.1
<i>Clitoria mariana</i>	4.2	0.3
<i>Coreopsis verticillata</i>	3.5	Absent

Soil pH, and concentrations of Ca, K, and P were significantly higher in associations containing *R. michauxii* than other associations on Fort Pickett. Radford et al. (1968) suggested that *R. michauxii* is perhaps associated with circumneutral soils. The mean pH of 5.9 appeared to suggest that *R. michauxii* may be associated with soils that are less acidic at Fort Pickett. However, Russo (1993) reported *R. michauxii* was not confined to less acidic soils in North Carolina. Christensen (1977) reported that there was a substantial increase in concentrations of Ca and K after fire in a southeastern pine/wiregrass savanna. In general, post-fire soils are known to experience an increase in pH (Woodmansee and Wallach 1978). Greater concentrations of the cations Ca and K in the soil of *R. michauxii* colonies at Fort Pickett could be attributed to their relatively high volatilization temperatures, which in turn could affect the soil pH (Boerner 1982). As a result, the higher pH found in soils associated with *R. michauxii* colonies at Fort Pickett might be an artifact of the fire regime found within the CAA and not a requirement itself. Results of the soil analysis should be considered preliminary. A more thorough analysis of the physical and chemical properties of the soils in *R. michauxii* colonies and other regions of the CAA would help determine what role these properties play in *R. michauxii* distribution.

## Ecological Assessment

The locations of the colonies and approximate positions of the buildings, roads, and extent tree clearing for the proposed MPRC, are presented in Map Insert 2. Currently the area is home to Ranges 15 and 16 and is used primarily for live-fire tracked vehicle training. As a result, the frequency and intensity of disturbance experienced by these colonies is likely to be higher than the other colonies within the CAA. In a majority of the colonies assessed, the tree stratum was sparse to non-existent, which can be attributed to the frequent disturbances. The paucity of the tree stratum and the dominance of (1) coppice hardwood growth (2) *L. cuneata* and (3) *R. michauxii* below 1 meter resulted in many colonies being classified within the open shrubland association. A notable exception was colony OL1-11. This colony was located in a sheltered, mesic cove that significantly limited the intensity of disturbance. As a result, the tree stratum was well developed and exhibited the highest cover of any visited colony. The herb stratum was dominated by *Stipa avenacea* L. which had not been previously encountered in any of the *R. michauxii* colonies. Consequently, this colony did not fit into the previously identified associations. Whether this represents a new association or was simply an anomaly is unclear at present.

The cover of *R. michauxii* followed the same pattern as reported earlier. In general, the lower the total cover above 3 meters, the higher the cover of *R. michauxii*. The *R. michauxii* in most of the colonies lacked significant cover above 1 meter, most likely the result of annual fires in this region of the CAA. However, colony OL1-11 again was the exception. Its lack of disturbance allowed *R. michauxii* individuals to attain heights in excess of 1 meter, which resulted in the high cover values above 1 meter in this colony.

Although rhizomatous growth is believed to be the primary mode of reproduction for *R. michauxii* at Fort Pickett, sexual reproduction is critical for the long term survival of the species. A majority of the assessed colonies had reproductive structures. However, training schedules dictated the timing of the field data collection in many instances and this prevented the identification of staminate and pistillate flowers. Nevertheless, evidence suggests that many of the examined colonies provide favorable conditions for sexual reproduction. Unpublished data related to this research found that open shrubland colonies at Fort Pickett had significantly higher densities of male and female ramets when compared with oak woodland colonies. Since a majority of the colonies in the ecological assessment were in the open shrubland association, the potential for sexual reproduction appears good for these colonies.

The possible construction of a MPRC will affect virtually all of the colonies examined in the ecological assessment. The exact effect that the construction will have upon the ecology and reproductive biology of *R. michauxii* cannot be adequately investigated until final construction plans are obtained. It is safe to assume that there will be both positive and negative effects upon individual colonies within the construction zone. However, the long term impacts upon the Fort Pickett *R. michauxii* population are unclear at this time.

## 7 Summary

Large *R. michauxii* colonies occur in two associations at Fort Pickett, the oak woodland association and open shrubland association. Disturbance caused by military training is required to maintain a healthy *R. michauxii* population at Fort Pickett. The physiognomic and floristic differences between the two associations are likely the result of different disturbance regimes. The open shrubland association experienced a higher level of disturbance than the oak woodland association. *R. michauxii* exhibited considerably higher cover in the open shrubland association.

A majority of the colonies examined in the ecological assessment were within the open woodland association and had reproductive structures. Evidence from earlier studies suggests that the habitat provided by the open woodland association may increase *R. michauxii* fecundity. A possible new *R. michauxii* association was discovered in a low-disturbance closed woodland. A majority of the colonies examined in the ecological assessment have the potential to be affected by the construction of a proposed MPRC.

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## **Appendix A: Data Sheets**

## Releve Data Sheets

Plot # / Polygon ID: \_\_\_\_\_

Site Name: \_\_\_\_\_

Quad. Name: \_\_\_\_\_

Surveyors: \_\_\_\_\_

Aerial Veg. Cover %	10 m +	6 - 10 m	2 - 6 m	1 - 2 m	1 - 0.5 m	0.5 - ground
80 - 100	C5	SC5	TSH5	LSH5	TH5	LH5
60 - 80	C4	SC4	TSH4	LSH4	TH4	LH4
40 - 60	C3	SC3	TSH3	LSH3	TH3	LH3
20 - 40	C2	SC2	TSH2	LSH2	TH2	LH2
10 - 20	C1	SC1	TSH1	LSH1	TH1	LH1
sparse - 10	C0	SC0	TSH0	LSH0	TH0	LH0

**Leaf type of Dominant Vegetative Layer**

- ☐ Broad-Leaved
- ☐ Needle-Leaved
- ☐ Mixed Broad & Needle-Leaved
- ☐ Microphyllous
- ☐ Graminoid
- ☐ Forb
- ☐ Pteridophyte

**Leaf Phenology (Uppermost layer with > 10% Aerial Veg. Cover)**

**Trees & Shrubs**

- ☐ Evergreen
- ☐ Deciduous
- ☐ Cold
- ☐ Drought
- ☐ Mixed
- ☐ Evergreen & Cold Decid.
- ☐ Evergreen & Drought Decid.

**Herbs**

- ☐ Annual
- ☐ Perennial

**Physiognomic Class:**

- ☐ Forest    ☐ Woodland    ☐ Sparse Woodland    ☐ Shrubland    ☐ Dwarf Shrubland
- ☐ Sparse Dwarf Shrubland    ☐ Herbaceous    ☐ Sparse Vascular Vegetation

[illegible]

## Ecological Assessment Information Sheet

Colony/GPS #: \_\_\_\_\_

Date: \_\_\_\_\_ Investigator: \_\_\_\_\_

County: \_\_\_\_\_ Aspect: \_\_\_\_\_ Slope: \_\_\_\_\_

Photos (y/n): \_\_\_\_\_ Photo/Roll #: \_\_\_\_\_ Soil Type: \_\_\_\_\_

### Site Disturbance:

- Old impact craters \_\_\_\_\_
- Recent fires \_\_\_\_\_
- Fire scarred trees \_\_\_\_\_
- Munitions/shrapnel \_\_\_\_\_

### Colony size:

- Small (less than 25 m<sup>2</sup>) \_\_\_\_\_
- Medium (25-200 m<sup>2</sup>) \_\_\_\_\_
- Large (200 m<sup>2</sup>) \_\_\_\_\_

### Vegetation:

#### *Tree Strata*

- Total Cover (3- 6 m) \_\_\_\_\_ Dominant Species \_\_\_\_\_

- Total Cover (6 + m) \_\_\_\_\_ Dominant Species \_\_\_\_\_

#### *Shrub Strata*

- Total Cover (1-3 m) \_\_\_\_\_ Dominant Species \_\_\_\_\_

#### *Herb strata*

- Total Cover (0 -1m) \_\_\_\_\_ Dominant Species \_\_\_\_\_

### *Rhus michauxii*:

#### Height:

- Cover Below 1 m \_\_\_\_\_

- Cover 1-2 m \_\_\_\_\_

- Cover 2 + m \_\_\_\_\_

Seed Heads: Yes \_\_\_\_\_ No \_\_\_\_\_

Flowers: Yes \_\_\_\_\_ No \_\_\_\_\_ Female \_\_\_\_\_ Male \_\_\_\_\_

## **Appendix B: Summary of Ecological Information**

**Colony ID:** OL1-1

**County:** Nottoway

**Aspect:** 30°

**Slope:** < 5%

**Disturbance (s):** Impact Craters, Recent Fires, Fire-scarred Trees, Munitions and Shrapnel

**Colony Size Class:** M

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>5</b>	<b>Associates:</b>	<i>R. michauxii</i> , <i>Lespedeza cuneata</i> , <i>Schizachyrium scoparium</i>
<b>1-3 m:</b>	<b>2</b>	<b>Associates:</b>	<i>Carya. tomentosa</i> , <i>Liriodendron tulipifera</i> , <i>Corylus cornuta</i>
<b>3-6 m:</b>	<b>1</b>	<b>Associates:</b>	<i>Quercus rubra</i> , <i>Q. falcata</i>
<b>6 + m:</b>	<b>3</b>	<b>Associates:</b>	<i>C. tomentosa</i>

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m:** 3

**1-2 m:** 0

**2 + m:** 0

**Reproductive Structures:** Seed Heads, Staminate and Pistillate Flowers

**Notes:** This colony lies within the proposed zone of tree clearing, but does not appear to be close to proposed roads or range buildings.



**Colony ID:** OL1-2

**County:** Nottoway

**Aspect:** 0

**Slope:** 0

**Disturbance (s):** Impact Craters, Fire-scarred Trees, Recent Fires

**Colony Size Class:** S

**Total Vegetative Cover:**

**0-1 m: 5 Associates:** *Lespedeza cuneata*, *Silphium compositum*,  
*Rubus spp.*

**1-3 m: 0 Associates:**

**3-6 m: 1 Associates:** *Pinus taeda*

**6 + m: 2 Associates:** *Pinus taeda*

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m: 2**

**1-2 m: 0**

**2 + m: 0**

**Reproductive Structures:** Seed Heads

**Notes:** Colony is located alongside target road. Colony is located on the border of the zone of tree clearing for the proposed MPRC. Has the potential to be affected by construction activities proposed directly east of the colony.

**Colony ID:** OL1-3

**County:** Nottoway

**Aspect:** 139°

**Slope:** < 5%

**Disturbance (s):** Recent Fires, Fire-scarred Trees, Munitions/Shrapnel

**Colony Size Class:** L

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>5</b>	<b>Associates:</b>	<i>S. scoparium</i> , <i>R. michauxii</i> , <i>Lespedeza cuneata</i> , <i>Desmodium</i> spp. <i>Silphium compositum</i>
<b>1-3 m:</b>	<b>2</b>	<b>Associates:</b>	<i>C. tomentosa</i> , <i>C. glabra</i> , <i>Q. velutina</i> , <i>Liquidamabar styraciflua</i>
<b>3-6 m:</b>	<b>3</b>	<b>Associates:</b>	<i>Q. velutina</i> , <i>C. glabra</i> , <i>P. taeda</i>
<b>6 + m:</b>	<b>2</b>	<b>Associates</b>	<i>Q. velutina</i>

***Rhus michauxii*:**

**Vegetative Cover**

**0-1 m:** 2

**1-2 m:** 0

**2 + m:** 0

**Reproductive Structures:** Seed heads, Staminate flowers observed in 1996.

**Notes:** The *R. michauxii* plants are patchy in their distribution throughout this colony. Within the colony boundaries there has been past soil disturbance through soil removal and demolition. The colony is within the zone of tree clearing for the proposed MPRC and could potentially be affected by road and building construction.

**Colony ID:** OL1-4

**County:** Nottoway

**Aspect:** 297°

**Slope:** < 5%

**Disturbance (s):** Recent Fires, Fire-scarred Trees

**Colony Size Class:** M

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>5</b>	<b>Associates:</b>	<i>Rubus spp.</i> , <i>Cercis canadensis</i> , <i>L. cuneata</i> , <i>Carya glabra</i> , <i>Rhus glabra</i> , <i>Panicum boscii</i> , <i>L. bicolor</i>
<b>1-3 m:</b>	<b>3</b>	<b>Associates:</b>	<i>Cercis canadensis</i> , <i>Carya tomentosa</i>
<b>3-6 m:</b>	<b>1</b>	<b>Associates:</b>	<i>Carya glabra</i>
<b>6 + m:</b>	<b>1</b>	<b>Associates:</b>	<i>C. glabra</i>

***Rhus michauxii*:**

**Vegetative Cover**

**0-1 m:** 1

**1-2 m:** 0

**2 + m:** 0

**Reproductive Structures:** None observed

**Notes:** Colony is patchily distributed beside Target Rd. The colony is within the zone of tree clearing for the proposed MPRC targets. The colony will also be potentially affected by road and building construction associated with the proposed MPRC.

**Colony ID:** OL1-5

**County:** Nottoway

**Aspect:** 290°

**Slope:** <5%

**Disturbance (s):** Old Impact Craters, Recent Fires, Fire Scarred Trees, Munitions and Shrapnel

**Colony Size Class:** M

**Total Vegetative Cover:**

**0-1 m: 5 Associates:** *R. glabra*, *L. cuneata*, *Rubus spp.*, *C. glabra*,  
*Cercis canadensis*, *P. boscii*

**1-3 m: 2 Associates:** *Carya glabra*

**3-6 m: 2 Associates:** *Q. velutina*, *C. glabra*, *Q. falcata*

**6 + m: 1 Associates:** *C. glabra*

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m: 1**

**1-2 m: 0**

**2 + m: 0**

**Reproductive Structures:** Flowers, not developed enough to tell if staminate or pistillate.

**Notes:** Colony is patchily distributed beside Target Rd. The colony may potentially be affected by road and building construction associated with the proposed MPRC.

**Colony ID:** OL1-6

**County:** Nottoway

**Aspect:** 0

**Slope:** 0

**Disturbance (s):** Recent Fires, Fire-scarred Trees

**Colony Size Class:** S

**Total Vegetative Cover:**

**0-1 m:** 5    **Associates:**    *L. repens*, *R. michauxii*, *L. cuneata*

**1-3 m:** 2    **Associates:**    *Rubus spp.*, *Nyssa sylvatica*,  
*Liriodendron tulipifera*

**3-6 m:** 1    **Associates:**    *N. sylvatica*, *P. taeda*, *Q. alba*

**6 + m:** 1    **Associates:**    *N. sylvatica*, *P. taeda*, *Q. alba*

***Rhus michauxii*:**

**Vegetative Cover**

**0-1 m:** 2

**1-2 m:** 0

**2 + m:** 0

**Reproductive Structures:** Almost all ramets have flowers, not developed enough to tell if staminate or pistillate.

**Notes:** The colony is not within the zone of trees clearing but may be affected by possible MPRC construction activities due to its proximity to Target Rd.

**Colony ID:** OL1-7

**County:** Nottoway

**Aspect:** 0

**Slope:** 0

**Disturbance (s):** Old Impact Craters, Recent Fires, Fire-scarred Trees, Munitions/Shrapnel

**Colony Size Class:** S

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>4</b>	<b>Associates:</b>	<i>R. michauxii</i> , <i>Panicum spp.</i> , <i>Desmodium spp.</i> , <i>R. glabra</i>
<b>1-3 m:</b>	<b>+</b>	<b>Associates:</b>	<i>C. tomentosa</i>
<b>3-6 m:</b>	<b>2</b>	<b>Associates:</b>	<i>C. tomentosa</i>
<b>6 + m:</b>	<b>1</b>	<b>Associates:</b>	<i>Q. stellata</i> , <i>Q. rubra</i>

***Rhus michauxii*:**

**Vegetative Cover**

**0-1 m:** 2

**1-2 m:** 0

**2 + m:** 0

**Reproductive Structures:** None observed

**Notes:** Colony lies within the zone of tree clearing for the proposed MPRC.

**Colony ID:** OL1-8

**County:** Nottoway

**Aspect:** 200°

**Slope:** 8%

**Disturbance (s):** Old Impact Craters, Recent Fires, Fire-scarred Trees, Munitions/Shrapnel

**Colony Size Class:** M

**Total Vegetative Cover:**

0-1 m: 5	<b>Associates:</b>	<i>Liquidambar styraciflua</i> , <i>R. glabra</i> , <i>R. michauxii</i> , <i>Panicum</i> spp. <i>Lespedeza cuneata</i> , <i>Desmodium</i> spp.
1-3 m: 1	<b>Associates:</b>	<i>Q. alba</i> , <i>C. tomentosa</i> , <i>Liquidambar styraciflua</i>
3-6 m: 1	<b>Associates:</b>	<i>C. tomentosa</i>
6 + m: 1	<b>Associates</b>	<i>C. tomentosa</i>

***Rhus michauxii*:**

**Vegetative Cover**

0-1 m: 2

1-2 m: 0

2 + m: 0

**Reproductive Structures:** Seed heads and flowers; flowers were not developed enough to distinguish between staminate and pistillate types.

**Notes:** Colony lies within the zone of tree clearing.

**Colony ID:** OL1-9

**County:** Nottoway

**Aspect:** 45<sup>0</sup>

**Slope:** <5%

**Colony Size Class:** S

**Disturbance (s):** Recent Impact Craters, Fire-scarred Trees, Munitions/Shrapnel

**Total Vegetative Cover:**

**0-1 m:** 4    **Associates:** *Rubus flagellaris*, *Lespedeza cuneata*, *R. michauxii*

**1-3 m:** 2    **Associates:** *C. tomentosa*

**3-6 m:** 2    **Associates:** *P. taeda*

**6 + m:** 0    **Associates:**

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m:** 2

**1-2 m:** 0

**2 + m:** 0

**Reproductive Structures:** Seed heads and flowers; flowers were not developed enough to distinguish between staminate and pistillate types.

**Notes:** Colony exists outside of the zone of tree clearing. Colony is located directly behind the second target mover on Range 15.



**Colony ID:** OL1-10

**County:** Nottoway

**Aspect:** 240

**Slope:** < 5%

**Colony Size Class:** S

**Disturbance (s):** Recent Severe Fire, all woody vegetation over 2 m destroyed

**Total Vegetative Cover:**

0-1 m: 5    **Associates:**    *Solidago spp. Ambrosia artemisifolia*

1-3 m: 0    **Associates:**

3-6 m: 0    **Associates:**

6 + m: 0    **Associates**

***Rhus michauxii:***

**Vegetative Cover**

0-1 m: 1

1-2 m:

2 + m:

**Reproductive Structures:** None observed.

**Notes:** Lies within the zone of tree clearing for the proposed MPRC.

**Colony ID:** OL1-11

**County:** Nottoway

**Aspect:** 290°

**Slope:** 12%

**Colony Size Class:** L

**Disturbance (s):** None

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>4</b>	<b>Associates:</b>	<i>Stipa avenecea</i> , <i>Cercis canadensis</i> , <i>Carya tomentosa</i> , <i>R. michauxii</i>
<b>1-3 m:</b>	<b>4</b>	<b>Associates:</b>	<i>C. tomentosa</i> , <i>Cercis canadensis</i>
<b>3-6 m:</b>	<b>3</b>	<b>Associates:</b>	<i>Carya tomentosa</i> , <i>Q. alba</i>
<b>6 + m:</b>	<b>3</b>	<b>Associates:</b>	<i>Q. alba</i> , <i>P. taeda</i> , <i>C. tomentosa</i> , <i>Liriodendron tulipifera</i>

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m:** 1

**1-2 m:** 2

**2 + m:** 0

**Reproductive Structures:** Flowers; flowers were not developed enough to distinguish between staminate and pistillate types.

**Notes:** Colony is within the zone of proposed tree clearing. Colony is located in a very mesic site that does not appear to burn often. Aerial vegetative cover above 3 meters is unusually high.

**Colony ID:** OL1-12; OL1-12a; OL1- 12b; OL1- 12c; OL1- 12d

**County:** Nottoway

**Aspect:** 45°

**Slope:** <5%

**Colony Size Class:** L

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel

**Total Vegetative Cover:**

0-1 m:	5	<b>Associates:</b>	<i>A. artemisifolia</i> , <i>Andropogon virginicus</i> , <i>Cassia fasciculata</i> , <i>L. cuneata</i> , <i>Rubus flagellaris</i> , <i>R. michauxii</i> , <i>Desmodium spp</i>
1-3 m:	4	<b>Associates:</b>	<i>Desmodium nudiflorum</i> , <i>L. cuneata</i>
3-6 m:	+	<b>Associates:</b>	
6 + m:		<b>Associates</b>	

***Rhus michauxii*:**

**Vegetative Cover**

0-1 m: 3

1-2 m: 0

2 + m: 0

**Reproductive Structures:** Seed Heads, Flowers; Staminate and Pistillate flower types observed in 1996. *Eurytoma spp.* also observed in 1996.

**Notes:** Very large colony that is sympatric with colony OL1- 13 ( OL1-12 & OL1-13 are shown as one colony on the distribution map). *Rhus michauxii* individuals are clumped in their distribution throughout this colony. Several subcolonies exist outside the perimeter of the main colony. There are numerous hulls and other parts of military vehicles, which previously had served as targets, strewn about the colony. *Rhus michauxii* was observed growing out of turrets of old tanks. Colony is within the tree clearing zone and target construction zone of the proposed MPRC.

**Colony ID:** OL1-13

**County:** Nottoway

**Aspect:** 45°

**Slope:** 10%

**Colony Size Class:** L

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel

**Total Vegetative Cover:**

**0-1 m: 5 Associates:** *L. cuneata*, *R. copallina*, *R. michauxii*,  
*Cornus florida*, *Panicum spp.*,  
*Sassafras albidum*

**1-3 m: 5 Associates:** *C. tomentosa*, *Cercis canadensis*

**3-6 m: + Associates:**

**6 + m: Associates**

***Rhus michauxii*:**

**Vegetative Cover**

**0-1 m: 2**

**1-2 m: 1**

**2 + m:**

**Reproductive Structures:** No reproductive structures observed. Flowers had been observed in 1996.

**Notes:** Very large colony that is sympatric with colony OL11- 12 ( OL11-12 & OL1-13 are shown as one colony on the distribution map). Unlike colony 12, there are no target vehicles in this colony. *R. michauxii* individuals are clumped in their distribution throughout this colony. Colony is within the tree clearing zone and target construction zone of the proposed MPRC.

**Colony ID:** OL1-14 , OL1- 14a, OL1-14b, OL1-14c, OL1-14d

**County:** Nottoway

**Aspect:** 45°

**Slope:** 32%

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel

**Colony Size Class:** L

**Total Vegetative Cover:**

**0-1 m:** 4    **Associates:**    *L. cuneata, Panicum spp., Danthonia sericea*

**1-3 m:** 2    **Associates:**    *P. taeda, Acer rubrum*

**3-6 m:** +    **Associates:**    *P. taeda*

**6 + m:**    **Associates**

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m:** 2

**1-2 m:**

**2 + m:**

**Reproductive Structures:** No reproductive structures observed.

**Notes:** Several subcolonies exist outside the perimeter of the main colony. Colony is within the tree clearing zone and target construction zone of the proposed MPRC.

**Colony ID:** OL1-15a ; OL1-15b

**County:** Nottoway

**Aspect:** 45°

**Slope:** 10%

**Colony Size Class:** L

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>5</b>	<b>Associates:</b>	<i>Rubus spp.</i> , <i>R. copallina</i> , <i>Cercis canadensis</i> , <i>Cornus florida</i> , <i>Vitis spp.</i>
<b>1-3 m:</b>	<b>4</b>	<b>Associates:</b>	<i>Liriodendron tulipifera</i> , <i>R. copallina</i> , <i>C. florida</i> ,
<b>3-6 m:</b>	<b>+</b>	<b>Associates:</b>	
<b>6 + m:</b>		<b>Associates</b>	

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m:** 3

**1-2 m:** 1

**2 + m:**

**Reproductive Structures:** Seed Heads, Flowers; flowers were not developed enough to distinguish between staminate and pistillate types.

**Notes:** Colony OL1-15 is made up of two large subcolonies. Colony is within the tree clearing zone and target construction zone of the proposed MPRC.

**Colony ID:** OL1-16

**County:** Nottoway

**Aspect:** 225°

**Slope:** <5%

**Colony Size Class:** M

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel,  
Recent Fire

**Total Vegetative Cover:**

<b>0-1 m:</b>	<b>4</b>	<b>Associates:</b>	<i>Schizachyrium scoparium</i> , <i>Desmodium</i> spp. <i>Lespedeza bicolor</i> , <i>Danthonia sericea</i>
<b>1-3 m:</b>	<b>1</b>	<b>Associates:</b>	<i>C. tomentosa</i> , <i>Q. velutina</i>
<b>3-6 m:</b>		<b>Associates:</b>	
<b>6 + m:</b>		<b>Associates</b>	

***Rhus michauxii:***

**Vegetative Cover**

**0-1 m:** 1

**1-2 m:**

**2 + m:**

**Reproductive Structures:** Seed Heads, Flowers; flowers were not developed enough to distinguish between staminate and pistillate types.

**Notes:** Outside of proposed construction and tree clearing zone.

**Colony ID:** OL1-17

**County:** Nottoway

**Aspect:** 90°

**Slope:** <5%

**Colony Size Class:** M

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel, Recent Fire

**Total Vegetative Cover:**

**0-1 m: 4 Associates:** *S. scoparium*, *R. radicans*, *Silphium compositum*, *Panicum spp.*, *Penstemon australis*

**1-3 m: + Associates:**

**3-6 m: 3 Associates:** *Q. velutina*, *L. tulipifera*, *C. tomentosa*

**6 + m: 2 Associates:** *Q. velutina*, *L. tulipifera*, *C. tomentosa*

***Rhus michauxii*:**

**Vegetative Cover**

**0-1 m: 2**

**1-2 m:**

**2 + m:**

**Reproductive Structures:** None observed.

**Notes:** Outside of proposed construction and tree clearing zone.



**Colony ID:** OL1-18

**County:** Nottoway

**Aspect:** 0

**Slope:** 0

**Colony Size Class:** L

**Disturbance (s):** Old Impact Craters, Fire-scarred Trees, Munitions/Shrapnel, Recent Fire

**Total Vegetative Cover:**

0-1 m: 4    **Associates:**    *S. scoparium*, *Lespedeza bicolor*,  
*Rubus flagellaris*, *Panicum spp.*

1-3 m: 3    **Associates:**    *C. glabra*, *L. bicolor*, *Q. velutina*, *C. tomentosa*

3-6 m: 2    **Associates:**    *C. glabra*, *Q. velutina*, *C. tomentosa*, *Q. alba*

6 + m:    **Associates**

***Rhus michauxii:***

**Vegetative Cover**

0-1 m: 3

1-2 m:

2 + m:

**Reproductive Structures:** Structures: Seed Heads, Flowers; flowers were not developed enough to distinguish between staminate and pistillate types.

**Notes:** Very large colony located on range 16, patchy distribution within colony. Outside of proposed construction and tree clearing zone.

**USACERL DISTRIBUTION**

Chief of Engineers

ATTN: CEHEC-IM-LH (2)

ATTN: CEHEC-IM-LP (2)

ATTN: CECC-R

ATTN: CERD-L

ATTN: CERD-M

Commander, U.S. Army Garrison and Fort Pickett

ATTN: AFRC-FMP-PW 23824 (15)

Defense Tech Info Center 22304

ATTN: DTIC-O (2)

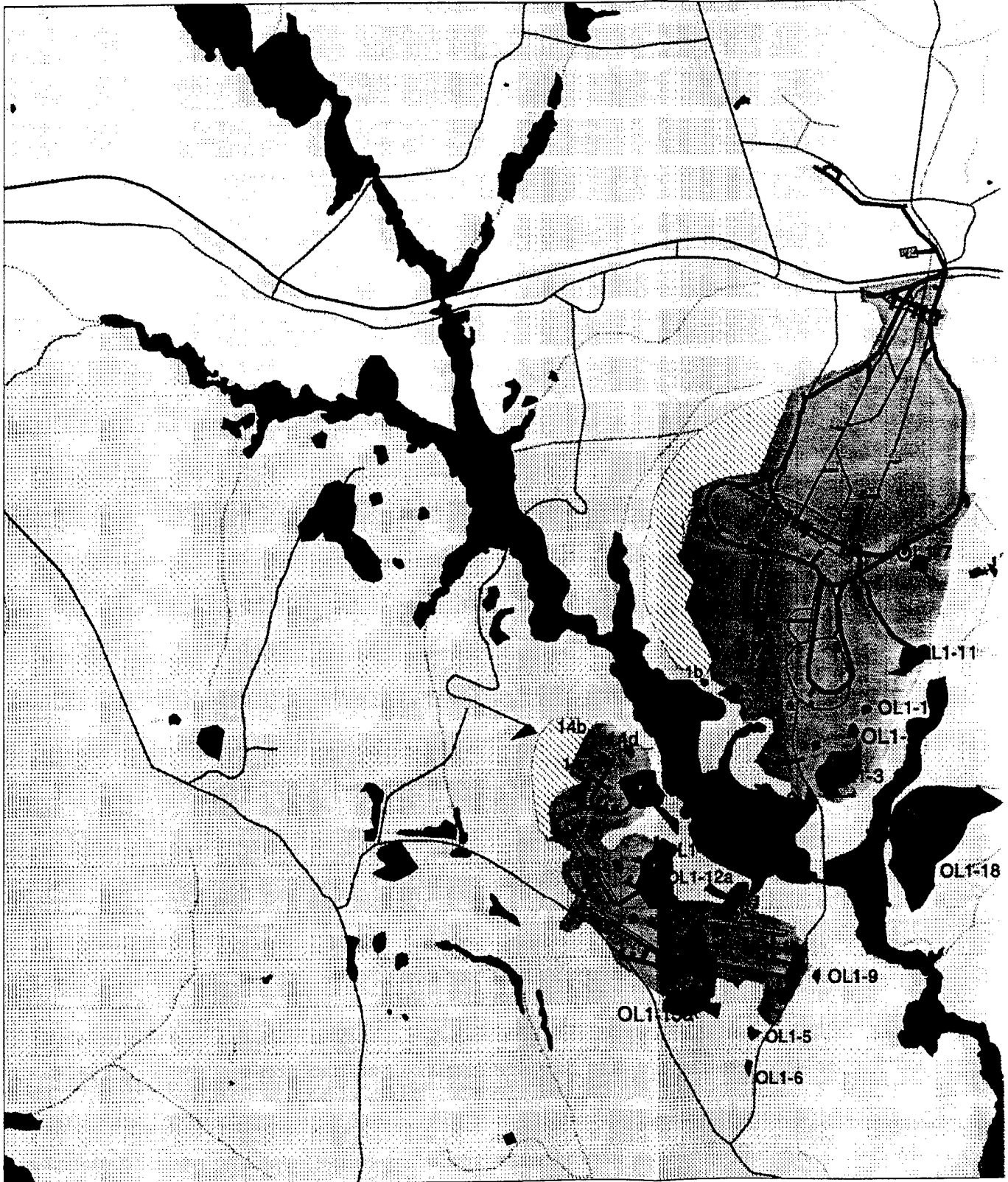
24

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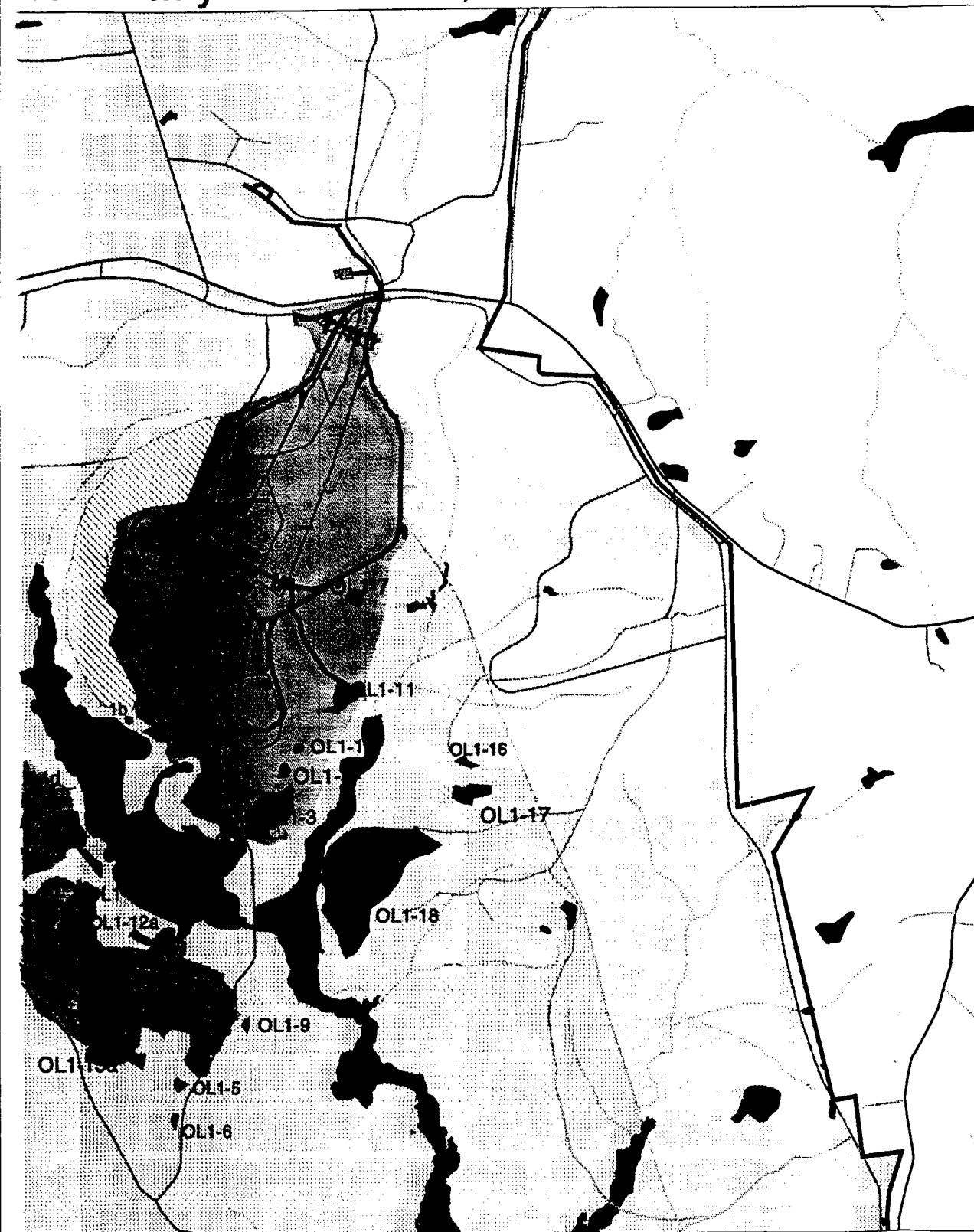
Map Insert 2

# Estimated Location of Proposed Fort Pickett Military Reservation

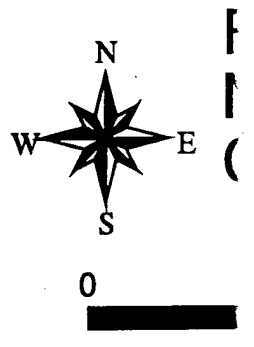


# Map Insert 2

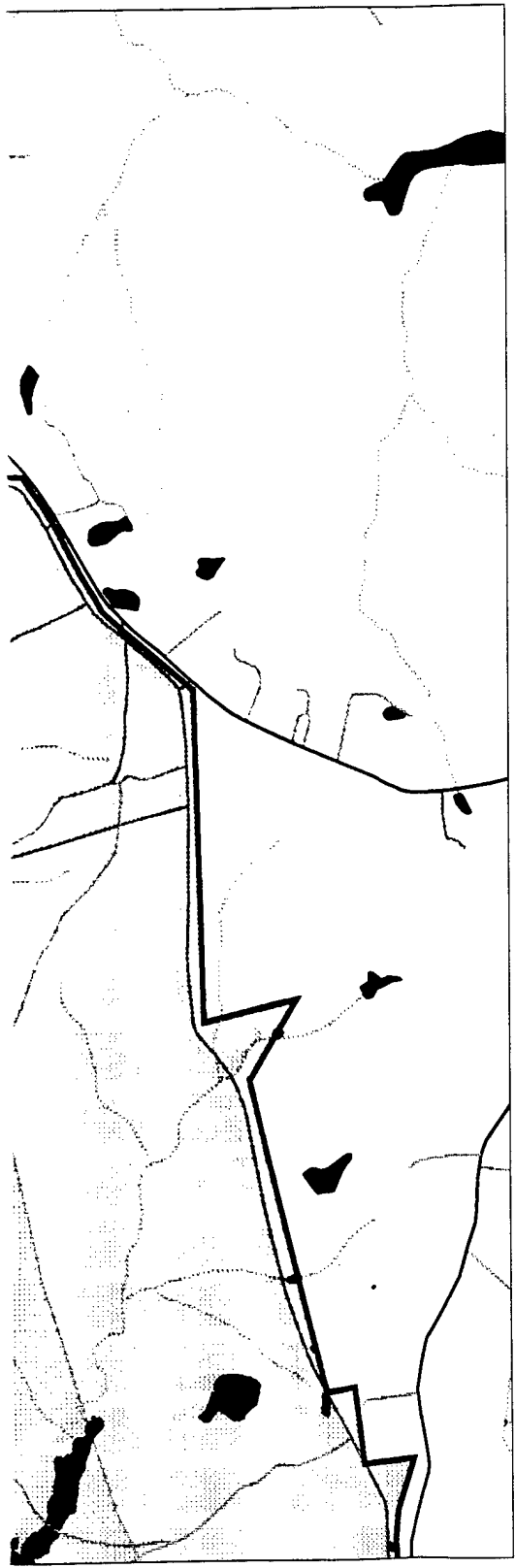
## Location of Proposed MPRC Fort Belvoir Military Reservation, VA



- Proposed MPRC
- Proposed
- Proposed
- Proposed
- Rhus mic
- Roads
- Light Dut
- Primary
- Secondary
- Undeveloped
- Water Bodies
- Wetlands
- Streams
- Possible
- Tree Clear
- Airstrips
- Controlled
- Fort Belvoir



PRC



LEGEND

- Proposed Range Structures
- Proposed Range Buildings
- Proposed Roads (Estimated Location)
- Rhus michauxii
- Roads
  - Light Duty
  - Primary
  - Secondary
  - Undeveloped
- Water Bodies
- Wetlands (NWI)
- Streams
- Possible MPRC Expansion
- Tree Clearing Limit (Estimated)
- Airstrips
- Controlled Access Area
- Fort Pickett Boundary

13-Jan-98

N  
W E  
S

Fort Pickett  
Natural Resources  
GIS Office

0 1 Kilometers